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ITALIAN PETROLOGICAL SKETCHES.

III. THE BRACCIANO, CERVETERI AND TOLFA REGIONS.

Bibliography.—The modern papers dealing with these three regions petrographically are extremely few, and since some of them are not confined to the description of only one they will be noticed together here.

We begin, as usual, with vom Rath,[1] who devotes parts of one Italian "Fragment" to Bracciano and to Tolfa. The descriptions are largely topographical, though in the Tolfa paper the "trachyte" is described and an analysis given, and considerable space devoted to the alum mines of the district. With exception of the paper just cited and a few stray notices of rocks in Rosenbusch's "Massige Gesteine," practically all the other articles on the regions are by Italians. Of these the following are the only ones which need be named here.

Struever[2] published in 1885 an account of the ejected blocks and their minerals which are found to the east of Lake Bracciano, but does not touch upon the eruptive rocks proper. Many of the eruptive blocks, and enclosures of Lake Bracciano, are described by Lacroix.[3]

In the same year Tittoni[4] describes the so-called Agro Sabatino, which includes the trachytic hills immediately to the west of Lake Bracciano, the region southwest of it, and the masses of eruptive rock near Cerveteri.[5] He gives a good geological map on a scale of 1 : 50,000. The first half of the paper is

[1] VOM RATH, Zeit. d. d. geol. Ges. XVIII, 561–576, 585–607, 1867.

[2] STRUEVER, Atti Acc. dei Lincei, Series 4, I, 1, 1885.

[3] LACROIX, Enclaves des Roches, Macon, 1893.

[4] TITTONI, Boll. Soc. Geol. Ital. IV, 1885, 337–376.

[5] He states that he was the first (in 1879) to discover the eruptive character of these hills.

devoted to the sedimentary terranes, while the latter half is taken up with brief megascopic descriptions of the eruptive rocks and their tuffs, and with their distribution. He considers that all of the eruptives are post-Pliocene.

The rocks of the Agro Sabatino collected by Tittoni, as well as others of the same region from other sources, were examined by Bucca[1] who also later[2] adds a note on the enclosures in the eruptive rock of Monte Calvario. His papers are entirely petrographical, and will be referred to later on in detail. Busatti[3] in the same year gives a description of a trachyte from Tolfa, to which Lotti adds some remarks on the genetic relationships. De Stefani,[4] later, also gives an account of the regions of Tolfa and Cerveteri.[5]

It will be evident from the above that the literature of the regions in question is of a very scanty description, the important leucitic rocks of Lake Bracciano being practically untouched, and the others not having been studied very fully. The regions in question are shown on the Tolfa and Bracciano sheets (Foglii 142 and 143) of the Italian Geological Map (scale 1 : 100,000).

THE BRACCIANO REGION.

Topography.—The center of this region is the large Lake of Bracciano. This is almost circular in shape and with a diameter each way of 9^{kms}. The surface of the lake is 164^{m} above sea level. On the north at Trevignano its symmetry is broken by a small bay which apparently represents a small explosive crater.

The depth of the water is not stated, though it seems to be much deeper than Lake Vico. There are no islands in the lake.

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[1] BUCCA, Boll. Com. Geol. Ital., 1886, 212–223.

[2] BUCCA, Loc. cit., 377–379.

[3] BUSATTI, Proc. verb. Soc. Tosc. 4, Luglio, 1886.

[4] DE STEFANI, Boll. Soc. Geol. Ital. X, 487–499, 1891.

[5] In a paper received just before going to press, P. MODERNI (Boll. Com. Geol. Ital. 1896, Nos. 1 and 2), describes the Bracciano center. He regards the mass as the product of eruptions from about 50 centers surrounding the lake, and this not as a true crater-lake but as due to a sinking in of the surface. He does not touch on the petrography.

Surrounding it is a circle of hills, whose steep inner sides come down close to the water's edge, leaving only a narrow shore margin. These hills are highest on the north, where they reach their maximum elevation in Monte di Rocca Romana (602^m), and from this gradually diminish in height around the lake toward the southern shore, where their height at Monti is only 336^m above sea level. From this circular crest the land here, as at Bolsena and Vico, slopes gradually down on all sides at a low angle, and presents much the same characteristic features.

To the east of the lake are three maar-like craters described by vom Rath. The largest of these is the dry circular Valle di Baccano, about 3^{km} in diameter. Between this and Lake Bracciano lie Lake Martignano (whose water level is 43^m above that of Lake Bracciano), and the Stracciocappa Marsh. These are all surrounded by ridges of tuff.

The walls and sides of the Bracciano Volcano are built up of leucitic lava flows and tuff beds, except on the west. On this side we find two small non-leucitic centers. About 3^{km} due west of Bracciano is the group of low hills which include Monti Oliveto and San Vito. These are partially covered by leucitic tuffs, so that they are older than some of these eruptions. To the north of them is a small solfatara, whose floor is white through decomposition of the rocks, and where sulphurous vapors are abundantly given off. To the north of this again is Monte Calvario,[1] a domal mass of eruptive rock. According to Tittoni this rests on Pliocene beds.

Petrography.— In this region my stay was of very short duration, so that the specimens collected and the observations made were few. A study of the geological map and my own observations are, however, sufficient to show that we have to deal here, as in the other centers, with two prominent groups of rocks, a non-leucitic and a leucitic. The group of phonolites proper seems to be lacking, or perhaps is present in only small amount.

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[1] It may be noted that BUCCA speaks of this last eruptive center as Monte Virginio. The hill of this name, which lies just north of Monte Calvario, is composed of tuffs enclosing blocks of leucitite, as shown on the geological map.

Toscanite.—The non-leucitic eruptive rocks of this region resemble the vulsinites and ciminites in containing basic plagioclase, as well as orthoclase, and are consequently quite rich in lime. They differ, however, in being much more acid, with SiO_2 from 63–72, and sometimes contain quartz. They, therefore, occupy a place intermediate between the rhyolites and the dacites. They correspond, in fact, very closely, both mineralogically and chemically, with the rocks of Monte Amiata described by J. F. Williams.[1] They also resemble the quartz-trachytes of Campiglia[2] and Roccastrada.[3] As these earlier known localities are in Tuscany (Ital. *Toscana*) this group of acid effusive rocks, characterized mineralogically by the presence of basic plagioclase, as well as orthoclase, with occasional quartz, and chemically by high silica and alkalies and (for the acidity) high lime, and low alumina, may be called *toscanite*. It may be mentioned that they also resemble certain rhyolites from Ponza and from the Euganean hills near Padua. They thus occupy the place in Brögger's[4] table filled by the group of quartz-trachyte-andesites, and in some cases are so acid as to fall in with his dellensite (dacite-liparite). They approach this especially in their low alumina. Analyses of typical toscanites will be found in Table I.

The rock of Monte Calvario is very much decomposed, so much so that good fresh specimens are difficult to find. I finally obtained some which are quite, though not entirely, fresh at a quarry on the southeast side where work was going on. The rock is rather coarse-grained and resembles many of the porphyries of our western states. The groundmass is light gray, and glassy feldspar phenocrysts abound, which are colored light yellow by the infiltration of ferruginous water. They are chiefly of sanidine with a smaller quantity of acid labradorite. Some quartz grains are present. Biotite flakes are not rare, though these and the augite phenocrysts have suffered much through weathering, being represented by brown limonitic spots in some of the specimens. Some large enclosures of a darker, fine-grained, vesicular rock were seen, which will be described presently.

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[1] WILLIAMS, Neu. Jahr. B. Bd. V, 381, 1885.

[2] VOM RATH, Zeit. d. d. geol. Ges. XVIII, 639, 1866. Also DALMER, Neu. Jahr. 1887, II, 206.

[3] MATTEUCCI, Boll. Com. Geol. Ital. 1890, 284 ff., and Boll. Soc. Geol. Ital. X, 670 ff., 1891.

[4] BRÖGGER, Eruptionsfolge bei Predazzo, Kristiania, 1895, 60.

In thin section the sanidine phenocrysts are seen to predominate over those of plagioclase. Examination of suitable sections of the latter shows it to be a labradorite of the approximate composition Ab_3An_4. They are clear, but inclusions are not uncommon, nearly always of brownish glass, and often in the shape of the host. A few instances of parallel growth were seen, a plagioclase core being surrounded by a border of alkali feldspar. This, however, forms one crystal individual with the plagioclase, and belongs to the same general period of crystallization, being sharply outlined and distinct from the groundmass. It is thus of a different character from the alkali feldspar mantles already noticed. A few rounded crystals of quartz are to be seen. The ferromagnesian minerals are represented by brown biotite and fewer pale green diopside crystals, both of which are much decomposed. The groundmass, which is almost holocrystalline, is made up chiefly of alkali feldspar flakes, very few laths being present, with some brown spots representing original pyroxene microlites. A little quartz may be present, but no plagioclase could be detected, though the rock is in such a condition that a satisfactory study of it was impossible.

This rock is described by Bucca as a quartz-trachyte. His description agrees closely with my own limited observations. He mentions, however, the presence of hypersthene, whose existence in my specimens may have been concealed by its well-known liability to decomposition.

The *enclosures* in this trachyte are apparently fragments of an early lava stream, brought up from probably no great distance below. They are dark gray, fine-grained and compact, and quite vesicular, though far from being scoriaceous. The line of junction between the enclosed and enclosing rock is sharp, and no great amount of contact metamorphism is apparent. In the gray groundmass are large tabular glassy sanidines and some rounded grains of quartz, but no ferromagnesian phenocrysts are to be seen. In many of the vesicles are slender brownish black needles of breislakite, and hexagonal scales of tridymite.[1] These enclosures are much less decomposed than the trachyte surrounding them, though the sanidines are stained slightly yellow.

Under the microscope the structure is strikingly like that of a dolerite. Very numerous prisms of colorless diopside, slightly brownish on the edges, and long plagioclase laths, whose extinctions show them to be labradorite of the composition Ab_1An_2, with fewer orthoclase laths, lie in a holocrystalline mesostasis of orthoclase. Some comb-like skeleton forms of labradorite are also seen. Magnetite is present though not abundant. A few larger phenocrysts of violet augite are seen, and the few sections of the large tabular sanidine phenocrysts met with are clear and show only a few inclusions of glass and apatite. A narrow orthoclase mantle surrounds them. There were found a number of grains of the peculiar brown barkevikite-like hornblende noticed in a leucite-tephrite of Bolsena. The extinction angle of $\mathfrak{c}$ on c was 17° and the pleochroism was identical. No olivine is present, but apatite needles are quite abundant.

The vesicular structure of this rock shows that it is not a segregation proper, but an inclosure of an earlier solidified lava mass which had been erupted on the surface. The breislakite and tridymite were formed prior to the eruption of the toscanite, since they are present in cavities revealed by breaking open good sized masses of the enclosures. The rock corresponds mineralogically, and probably more or less closely chemically, with the vulsinites, though the structure is quite different. It probably represents one of the earliest outflows of the volcanic center, carried up by the later toscanite. Bucca (*op. cit.* 377) gives a very good description of these enclosures which agrees closely with the above. The hypersthene he speaks of as present is perhaps to be referred to the barkevikite just mentioned.

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[1] BUCCA also notes hypersthene and augite crystals.

The toscanite of Monte San Vito is structurally quite different from that of Monte Calvario. The predominating dark brownish black mass is highly vitreous, with a few irregular cavities which are lined with a light blue gray opal. Through this are scattered many quite large glassy tabular sanidines, in almost every case twinned according to the Carlsbad law. They are stained slightly yellow and many carry the bluish opal in the crevices. Some irregular quartz grains are also visible, but phenocrysts of ferro-magnesian minerals are wanting.

The large sanidines are seldom met with in thin sections, but of the smaller phenocrysts those of feldspar are the most abundant. Those of plagioclase are in the majority over those of orthoclase, and Michel-Levy's method shows this to be labradorite of the composition Ab_2An_3. The crystals, both of labradorite and of orthoclase, are automorphic and sharp in outline, showing the usual planes. They are clear and quite free from even incipient alteration. Inclusions of pale brown glass are common, often with a bubble and sometimes of the shape of the host. Pale diopside, apatite and magnetite are also included in the feldspars. These feldspars are often clustered together, but no distinct relative order of crystallization could be made out between the two. The diopside is in stout well-formed crystals, usually with a pyramid largely developed. It is almost or quite colorless, and inclusions are rare and almost wholly of brown glass. A number of small thick tables of brown biotite are present which invariably show a narrow border of fine-grained augite-magnetite aggregate. A few large grains of magnetite and some apatite needles complete the list. In my few specimens I could detect none of the hypersthene mentioned by Bucca as abundant. The groundmass is highly vitreous, consisting of a largely predominating light brown glass base, in which are sprinkled, with little evidence of flow structure, many minute orthoclase and fewer prismatic diopside microlites. Small magnetite grains are rare and are perhaps derived from altered biotite, as may also be the case with part of the diopside microlites. An analysis of this rock by Dr. Röhrig is given in Table I, No. 1. It is seen to be as high in silica as a trachyte, low in alumina, with rather andesitic amounts of lime and magnesia, and in alkalies standing between the two groups, though the relative amounts of potash and soda are not what we might expect.

The rock just described, as well as similar ones from other localities in the region, are called by Tittoni "trachytic retinites." Bucca describes them as augite-andesites, with which name his descriptions agree very well, though it seems to me, as it does to de Stefani, that he unreasonably neglects the abundant sanidines and quartz. He speaks of hypersthene as abundant, and gives extinction angles for the plagioclase[1] from which he concludes that they must be very basic—"from labradorite to anorthite." According to him orthoclase only occurs as the large tabular phenocrysts, which is certainly not the case in my specimens.

Leucitite.—The leucitic rocks collected by me belong to three groups, leucitite, leucite-tephrite, and leucite-phonolite. Specimens of the first were obtained south of Lake Bracciano, from a flow at Crocicchie, from a similar, or the same, flow about one kilometer west of this and from the quarry at L'Uomo Morto southwest of the lake. A similar rock was seen also at Oriolo, northwest of the lake, but I have no specimen of it. They are all compact, dark gray, basaltic looking rocks, with some fresh well-shaped leucite phenocrysts (0.2 to 1 ^{cm}) and a few smaller ones of augite.

Under the microscope the phenocrysts present no remarkable features. The leucites are clear, somewhat cracked, show quite strong double refraction, and contain few inclusions. The augites are well shaped, pale green and not pleochroic, generally darker toward the center, and with an extinction angle of about 42°. Some are seen with a fringe of later dark green augite at the ends, which extinguishes at an angle of 50° and includes some magnetite grains.

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[1] He says that they vary from 35° to 59°. There seems to be some error here.

The groundmass is almost holocrystalline, and is made up chiefly of small round leucites. In two cases these contain only few peripheral inclusions of augite and apatite needles, a peculiar feature being that around the leucite crystals proper as defined by these rings, is a late growth of leucite which extends irregularly and acts as a mesostasis for the other constituents. In rock from the second locality mentioned the inclusions are more numerous, and in spots due to skeleton growth, as has been previously described, though the skeleton forms are not as perfect as some of those seen elsewhere.

Between these leucites is an interstitial mass of green or greenish brown augite needles and grains, with some magnetite grains, with the latter being associated flakes of orange red hematite. Spots of a colorless feebly doubly refracting substance, giving bright grays of the first order in my very thin sections, are referred to alkali feldspar, as treatment with acid revealed no nepheline. No melilite was seen. Glass base is present in a very small amount. An analysis of one of these leucitites is given in Table I, No. 5.

The leucitite of Santa Maria di Galera,[1] which belongs to this volcano, resembles the above very closely under the microscope, though it is much coarser in structure. A rock very similar to these is found as loose blocks in the yellow tuff of Monte Virginio. This is very much finer grained than any of the preceding; contains some plagioclase but no glass.

Leucite-tephrite.—This seems to be quite common in the region though not so much so as leucitite. It is represented by a specimen from a lava stream in the crater wall just below the town of Bracciano. It is rather dark and fine grained, but rough in texture and not aphanitic. Scattered through the groundmass are very many small clear leucites and some very small black augites.

Under the microscope it closely resembles the similar rock of the Bolsena region, having the same doleritic structure. The irregularly shaped leucites show strong double refraction, and carry few inclusions. The augite is in stout prismatic crystals, green in color and generally darker toward the center. Large grains of magnetite abound, which are accompanied by orange hematite flakes. Many lath-shaped crystals of a basic labradorite, with a little orthoclase, are present with these, and the interstitial colorless glass base contains only few augite microlites and some minute opaque grains. An analysis is given in Table I, No. 6.

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[1] ROSENBUSCH, Mikr. Phys. II, p. 1233, 1896.

Leucite-phonolite.— My only specimen of this was collected at a rather thick flow on the northwest shore of the lake close to the water's edge. The groundmass is compact and fine-grained, of a very light gray color and with a slightly greasy luster. Clear rather glassy leucites and minute black augites occur as phenocrysts. Examined with the microscope the large leucites show the twinned structure very finely, and the prismatic augites are of an olive-green color, with the pleochroism and other characters of aegirine-augite.

In the holocrystalline groundmass are many small olive-green aegirine-augite prisms, a few colorless haüynes showing the characteristic inclusions, and some magnetite grains. The feldspars are represented by stout crystals and grains of alkaline feldspar, which are occasionally twinned. There is also present a residual base of colorless, feebly doubly refracting nepheline, whose identity was established by treatment with acid and fuchsine. Plagioclase is absent. A peculiar feature of the groundmass is the presence of round spots of a clear substance, whose outlines are defined by rings of minute augite microlites with some magnetite grains. These seem at first sight to be groundmass leucites. Close examination under crossed nicols, however, reveals the fact that only a small percentage of them is really of this mineral. The majority are composed of nepheline, with some orthoclase grains and crystals, the latter occasionally in fan-shaped aggregates. We have here, then, a case of paramorphism of leucite into "pseudo-leucite"—a mixture of nepheline and orthoclase, such as has been observed in Arkansas,[1]

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[1] J. F. WILLIAMS, Ark. Geol. Sur., 1890, II, 267.

Brazil,[1] and Montana.[2] It is difficult to understand why the small groundmass leucites should suffer this change, while the larger phenocrysts remain preëminently fresh and unaltered.

Bucca does not describe any of the leucite rocks of the Bracciano region.

THE CERVETERI REGION.

This region[3] lies about 10^{km} southwest of Lake Bracciano and north of the small town of Cerveteri, so famous for its Etruscan tombs. It consists of a small group of hills, extending about 8^{km} W. N. W. and E. S. E. (about parallel with the coast line, and 4 to 5^{km} broad. They are of no very great altitude, the hills reaching their maximum height of 384 meters in Monte Cerchiara, in the center of the group. I could only spend the better part of one day at the eastern end, but as far as my observations permitted me to judge they are a mass of domal eruptions resting, as Tittoni points out, on Pliocene beds.

They are composed almost exclusively of acid non-leucitic rocks and their tuffs. Some leucitite is met with at the eastern end, but these leucitic lava streams probably belong to the Bracciano volcano proper. Since this leucitite is met with beneath the "trachytic" masses, its occurrence is of great interest as showing that the earliest leucitic outflows of Bracciano are of an earlier date than those of Cerveteri, though they continued after these latter had ceased. There seems to me to be an intimate connection between the Bracciano center and that of Cerveteri, and probably also that of Tolfa, but my opportunities for observation were so few that I do not feel able to discuss this point at present.

Toscanite.—To this group belong all the specimens collected by myself, and also apparently all those described by Bucca, except those of a few leucitites. Their prominent mineralogical and chemical characteristics have already been noted.

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[1] HUSSAK, Neu. Jahrb. 1892, II, 146.

[2] PIRSSON, Am. Jour. Sci., II, 194, 1896.

[3] It is included on the Bracciano Sheet (Foglio 143) of the Italian Geologic Map.

The rock of which Monte Cucco, at the extreme east end of the region, is composed, is a light gray porphyritic rock, many glassy feldspar phenocrysts and some of biotite lying in a rather vitreous brownish groundmass. Under the microscope there appear well shaped and uncorroded clear orthoclase and plagioclase phenocrysts, the former in the majority. The plagioclase is shown by Michel-Levy's method to be labradorite of the composition $Ab_2\ An_3$, the symmetrical extinction angles of the lamellæ of the Carlsbad individuals being in one individual 26° and in the other 29°. There are also many tables of an olive green biotite, which shows no corrosion or alteration phenomena. A few large colorless diopsides also appear. There is no magnetite, and no quartz could be detected.

The groundmass is highly vitreous, the glass base being colorless or of a very pale brown. It shows perlitic cracking in great perfection. Through it are sprinkled small (0.01–0.02) microlites of diopside, and a few stout orthoclase microlites which often show "horns" at each end. An interesting feature is the occurrence in abundance of very small (about 0.05^{mm}) forked and sheaf forms of orthoclase, which correspond to the so-called keraunoids in Ischian trachytes already described by the writer.[1] These keraunoids are of such minute dimensions that they exert only a feeble action upon polarized light, but examination of the largest shows that the axis of greatest elasticity $\mathfrak{a}$ lies parallel to the length, and that therefore they are elongated in the direction of the axis *a*. The use of high powers proves that they are in every way identical with those described from Ischia, except that they are of much smaller dimensions and more delicate.

Bucca's description of this rock closely agrees with the above, though he speaks of the biotite as being brown, and the small augites and keraunoids seem to have been lacking in the groundmass of his specimens. Though no quartz is present he is of the opinion that these rocks are to be referred to the same acid group as those of Monte Calvario. This opinion is confirmed by my analysis given in Table I, No. 2, which may be taken as representative of the rocks of this region.

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[1] WASHINGTON, Am. Jour. Sci., I, 375, 1896.

The rocks of Monte Lungo and Monte Ercole, west of Monte Cucco, are rather darker and rougher in groundmass, and look like the Arsotrachyte of Ischia, minus olivine. The plagioclase is, however, rather more basic, having a composition Ab_1An_2, and the biotite rather browner in tone though still green, and colorless diopside phenocrysts rather more frequent. The glass base is rather dark brown, and the small orthoclase keraunoids are much more abundant, as are also the diopside microlites, which are here prismatic in habit. The rock of Belvedere del Principe south of Monte Ercole, is also closely similar in general characters, but the orthoclase keraunoids are here so abundant as to give the base a hyalopilitic structure. The glass is brown and the diopside microlites are prismatic in habit and show some flow structure.

It may be noted that absolutely no magnetite is to be found in any of these rocks. Small apatite needles are found in all, especially as inclusions in the feldspars. Bucca mentions a brown hornblende as present, known by its prismatic angle and oblique extinction, but careful research failed to reveal it in my specimens. As has been said, analysis No. 2 of the Monte Cucco rock may be regarded as representative of them all, and its close resemblance to that of the Tolfa and Calvario rocks will be noted. Further remarks on these points must be reserved for the final paper.

Leucitite.—This is represented by a specimen from a flow met with at the bottom of the deep ravine immediately to the west of Monte Cucco, whose rocks overlie it, though tuffs and soil conceal the contact. It is almost identical with the leucitites from the south of Lake Bracciano, and is composed essentially of round and irregular leucites with insterstitial green augite needles. Some magnetite and a very little orthoclase are also present.

The rock of which the ruined Castle Dannato is built was obtained from some now forgotten quarry in the neighborhood.

It is also a leucitite, and of the same composition as the preceding. It is, however, of much finer structure and closely resembles the leucitite of Sassi Lanciati near Bolsena. It carries segregations of coarse-grained, granitic masses, made up of large grains of green augite and a few well formed crystals of olivine, with much leucite which shows excellent twinning lamellæ, and which takes the place of the feldspar in typical gabbros. Some cavities are filled with calcite. These segregations closely resemble the leucitic blocks briefly described by Lacroix from Lake Bracciano, and may be compared with the Missourite recently described by Pirsson.[1]

THE TOLFA REGION.

This region consists of a triangular group of hills, lying a little more than 10^{km} northeast of Civita Vecchia and some 20^{km} west of Lake Bracciano. Its highest point is Monte Sassicari, 525^{m} above sea level. Since my visit of a few hours was confined to the southern angle I will not go into the topography, which moreover presents little of interest here. It may only be noted that the hills are composed essentially of toscanite, which in general is so extremely decomposed to alunite that a fresh specimen of rock is indeed a *rara avis*. De Stefani points out that the eruptions in all probability took place in post-Pliocene time, differing in this from Ponzi and others, who would place them earlier.

Petrography.—According to vom Rath there are two distinct kinds of "trachyte" represented in the region. The one is a "sanidine-oligoclase-trachyte" with light gray compact groundmass, in which lie phenocrysts of sanidine, oligoclase and biotite. This is more abundant in the northeastern part of the region, often shows a bed-like parting, and is comparatively little subject to decomposition. The other is more like a pitchstone, and is almost universally decomposed. Its groundmass is dark brown and resinous, with phenocrysts of sanidine, biotite and augite. To these Busatti adds a third variety, though his description hardly seems to warrant the separation.

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[1] PIRSSON, Am. Jour. Sci., II, 315, 1896.

I am inclined to agree with de Stefani in thinking that there is only one kind of rock, and that the differences noted are of very small importance. From vom Rath's analysis of the pitchstone-like trachyte and from mine of the rock from Tolfa it will be seen that the two varieties closely resemble each other chemically and that the rock belongs to the group of Toscanites as already defined.

The only fresh specimens which I obtained were collected at the hill on which stands the old castle above the village of Tolfa. In all other places I found it so decomposed as to be absolutely worthless for petrographical study. The groundmass is very compact and bluish gray, and speckled with minute black spots of augite. Very many large glassy feldspar phenocrysts, which often show twinning, with some biotites are scattered through it.

Under the microscope this rock presents an appearance almost identical with that of the Monte Cucco rock. The rather abundant plagioclase is an acid labradorite having the composition $Ab_1 An_1$, as determined by the extinction angles (22° and 23°) of the albite-twinned lamellæ of the two individuals of a Carlsbad twin.[1] The feldspar phenocrysts are quite often corroded. The hyalopilitic groundmass has a colorless glass base, which is thickly crowded with diopside prisms and laths, rather than keraunoids of orthoclase.

De Stefani[2] mentions a leucitic rock which he obtained at the base of Monte Elceto between the toscanite and the underlying Cretaceous rocks. Rosenbusch, to whom a specimen was sent for examination, reports that it is a "leucitite perfectly identical with the leucitic rocks of Albano and the vicinity of Rome."

[1] BUSATTI states that the plagiolase is oligoclase, but his determination seems to rest on insufficient data, as he only mentions its "polysynthetic structure" but gives no angles, as neither does VOM RATH.

[2] DE STEFANI, Boll. Com. Geol. Ital., 1888, 224.

TABLE I.

	1	2	3	4	5	6	7
SiO_2	64.04	66.24	65.19	67.61	47.89	49.73	55.87
Al_2O_3	14.48	15.64	16.04	14.04	18.25	19.20	21.82
Fe_2O_3	1.73	1.16	1.16	....	4.93	5.50	2.34
FeO	4.35	2.19	2.48	5.40	3.64	2.41	1.10
MgO	1.03	0.89	0.99	0.65	3.68	2.63[1]	0.48
CaO	4.00	2.17	2.92	3.71	8.70	7.96	3.07
Na_2O	4.14	2.05	2.26	5.50	2.60	1.99	4.81
K_2O	3.65	6.60	6.11	2.41	8.23	9.39	10.49
H_2O	2.06	3.25	1.85	2.28	0.65	1.19	0.34
TiO_2	0.28	....	....	....	0.77	....	....
	99.76	100.19	99.00	101.60	99.34	100.00	100.32
Sp. Gr.	2.542	2.455	2.509	2.537	2.781	2.655	2.551

1. Toscanite, Monte Calvario, Bracciano, A. Röhrig anal.
2. Toscanite, Monte Cucco, Cerveteri, H. S. Washington anal.
3. Toscanite, Castle Hill, Tolfa, H. S. Washington anal.
4. Toscanite, Tolfa, vom Rath, *op. cit.*, 596.
5. Leucitite, Crocicchie, Bracciano, H. S. Washington anal.
6. Leucite-tephrite, Bracciano, H. S. Washington anal.
7. Leucite-phonolite, Lake Bracciano, H. S. Washington anal.

HENRY S. WASHINGTON.

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[1] By difference, through loss of Mg precipitate.